Islamic University of Gaza
Hydraulics (ECIV 3322)
Second Semester (2014-2015)
Second Midterm Exam

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Allowable Time: 1^{hr}

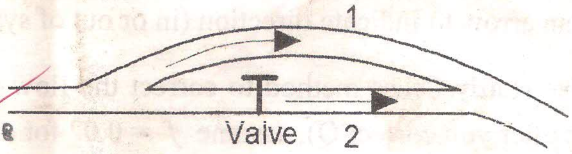
$19\frac{1}{2}$ / 20

Student Name: ______

Question 1: (5 Points) $4\frac{1}{2}$

Answer the following questions:

1. For the shown figure, if the following data are given: f_1=f_2=0.02 , L_1=200m, L_2=180m, D_1= 0.3m, D_2=0.2m, Q_1 = 0.3 m^3/s and the valve is open with minor loss coefficent K = 5. What is the flow rate in pipe 2?



$h_{f_1} = h_{f_2} + h_{m_2}$

$\frac{8\times0.02\times200\times0.3^2}{9.8\times0.3^5\times3.14^2} = \frac{0.02\times180\times V_2^2}{2\times9.8\times0.2} + 5\frac{V_2^2}{2\times9.8}$

$112.26 = 0.918\,V_2^2 + 0.255\,V_2^2$

$1.173\,V_2^2 = 112.26$

$V_2 = 3.23$ $Q = 3.23 \times \frac{0.2^2\times3.14}{4} = 0.101\ m^3/s$

2. The maximum and minimum velocities in water distribution networks are 0.6 and 2m/s respectively? Why these limits are required?

Minimum velocity (0.6m/s): حتى لا يصبح هناك ترسبات في المواسير وبالتالي يحدث clogging

Maximum velocity (2m/s): حتى لا يتم اتلاف سطح pipe لأنه يحدث له تقشر مع الزمن (حت)

3. In solving distribution networks problems, the following conditions must be satisfied simultaneously:

a) $\Sigma Q = \Sigma Q_{in} - \Sigma Q_{out} = 0$ at each junction.

b) $\Sigma h_f = 0$ for each loop.

4. The disadvantages of branching system are:

a) لو حدث عطل يضطر لإيقاف كل ما بعد العطل وإيقاف الخدمة عنهم

b) النهايات المغلقة يحدث فيها ترسبات وتنمو فيها البكتيريا طول الطاحة
انخفاض المياه تقل كلما كبر النظام ومن نهاية

5. Celerity of the water hammer pressure wave depends upon the following :

a) Density of fluid

b) سرعة إغلاق الـ valve

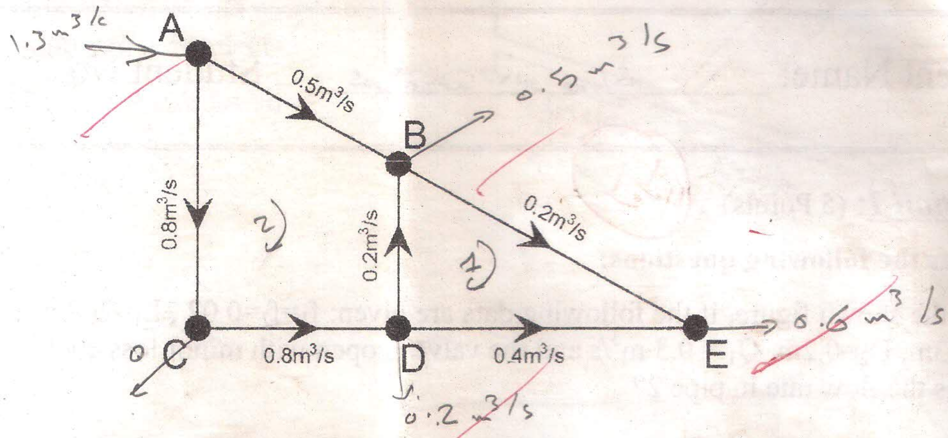
سرعة اعادة قبل إغلاق valve

$\frac{1}{2}$

8

Question 2 (8 Points)

For all pipe segments, the **initial estimate of the flow** in each pipe (m^3/s) is shown in the figure below.



a) Show on the sketch all sources and sinks (in and out flows) of water from the pipe network. Use an arrow to indicate direction (in or out of system) and give the magnitude of the flow.

b) Use Hardy-Cross method to correct the flow rate through each pipe. Do only one iteration (stop after you correct Q), assume $f = 0.02$ for all pipes and neglect minor losses.

c) If the pressure head at A = 90m, determine the pressure head at E.

Pipe	L(m)	D(m)
AB	250	0.5
AC	350	0.6
CD	200	0.6
DB	180	0.2
DE	380	0.4
BE	400	0.2

Node	Elevation (m)
A	20
B	25
C	28
D	25
E	30

loop 1

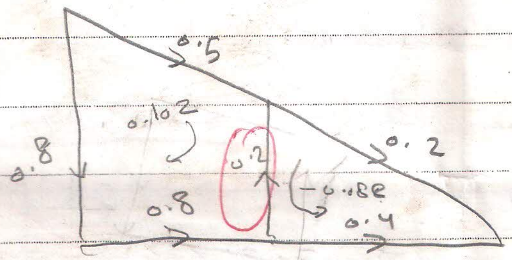
Pipe	L	D	f	Q	h_f	h_f/Q
BE	400	0.2	0.02	0.2	82.79	413.95
ED	380	0.4	0.02	-0.4	-9.83	24.57
DB	180	0.2	0.02	0.2	37.25	186.25
					110.21	624.77

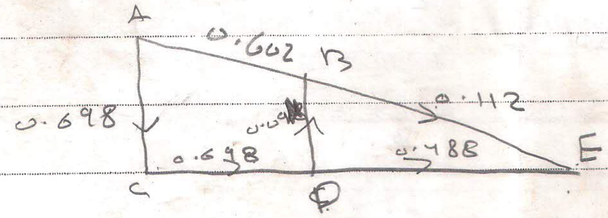
$$\Delta = -\frac{110.21}{2\times 624.77} = -0.088 \ m^3/s$$

loop 2

Pipe	L	D	f	Q	h_f	h_f/Q
AB	250	0.5	0.02	0.5	3.31	6.62
BD	180	0.2	0.02	-0.2	-37.25	186.25
DC	200	0.6	0.02	-0.8	-2.72	3.4
CA	350	0.6	0.02	-0.8	-4.77	5.96
					-41.43	202.23

$$\Delta = \frac{+41.43}{2 \times 202.23} = 0.102 \ m^3/s$$





pipe	Q
AB	0.602
BE	0.112
AC	0.698
CD	0.698
DE	0.488
BD	0.01

$$Th_{@A} = Th_E + h_f$$

$$90 + 20 = H + \frac{8 \times 0.02 \times 0.602^2 \times 250}{3.14^2 \times 9.8 \times 0.5^5} + \frac{0.02 \times 8 \times 0.112^2 \times 400}{3.14^2 \times 9.8 \times 0.2^5}$$

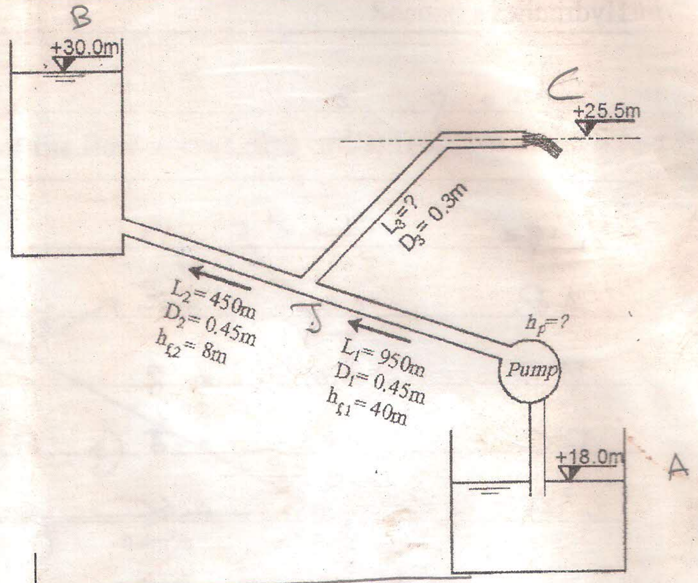
$$H = 110 - 4.8 - 25.96$$

$$= 79.24$$

$$P = 79.24 - 30 = 49.24$$

Question 3: (7 Points) 7

In the shown figure, determine **the total length of pipe 3 (L_3) and the head delivered by the pump (h_p)**. Neglect minor losses and take $f = 0.032$ for all pipes.



$Th_A = Th_B + h_f - h_p$

$18 = 30 + 40 + 8 - h_p$

$h_p = 60$ m ✓

$Th_A = Th_J + h_f - h_p$

$18 = Th_J + 40 - 60$

$Th_J = 38$ m ✓

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flow from J → C

$Th_J = Th_c + h_f$

$$38 = 25.5 + \frac{8 \times 0.032 \times L \times Q_c^2}{3.14^2 \times 9.8 \times 0.3^5} \rightarrow (1)$$

$$40 = \frac{8 \times 0.032 \times 950 \times Q_A^2}{3.14^2 \times 9.8 \times 0.45^5}$$

$Q_A = 0.541$ m³/s ✓

$$8 = \frac{8 \times 0.032 \times 450 \times Q_B}{3.14^2 \times 9.8 \times 0.45^5}$$

$Q_c = 0.351$ ✓

$Q_B = 0.541 - 0.351 = 0.19$ ✓

from 1

$L = 317.58$

0.03936